

Superconducting Qubits and Quantum Gates for Scalable Quantum Computing

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This project (9/1/2003 -) addresses several key problems for the development of quantum computers which are predicted to be able to solve a number of very important problems that are intractable for existing projected classical computers. An enormous obstacle to the development of these advanced computers is to maintain the quantum mechanical coherence among all its elements throughout a calculation. This project will make use of the highly coherent state of superconducting material to form the basic element, or qubit, of the computer. This approach will also permit the use of integrated circuit technology to scale the computer to a useful size. A major focus will be solving the fabrication and design issues to minimize decoherence.

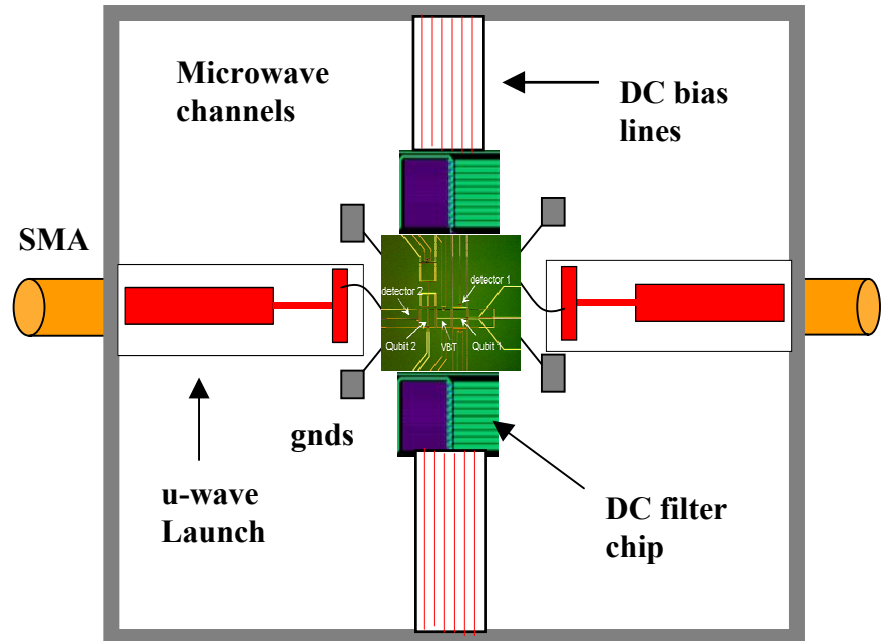


Figure 1. Layout of a superconducting flux quantum bit (qubit) with integrated microwave launcher and filters in a multi-chip module package.

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Education:

This project is a collaboration of experimentalists and theorists from three institutions – the University of Kansas, State University of New York at Stony Brook, and Communication Research Laboratory. The project will train a large number of undergraduates, graduate, and postdoctoral students. These students will receive training in the state-of-the-art fabrication and measurement technology required for this project along with the theory of decoherence in macroscopic systems—a field of rapidly emerging importance to strengthen our nation's scientific and technological competitiveness.

Outreach:

The PIs will organize and participate in a variety of outreach activities aimed at promoting science education to public in general and to underrepresented minority group students in particular.



Figure 2. The state-of-arts fabrication facility of superconducting integrated circuits at the Communication Research Laboratory.